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Brief Fear of Movement Scale for Osteoarthritis

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Abstract

Objective—Fear of movement has important clinical implications for individuals with osteoarthritis. This study aimed to establish a brief fear of movement scale for use in osteoarthritis. Items from the Tampa Scale for Kinesiophobia (TSK) were examined.

Methods—The English version of the TSK was examined in a community-based sample (N=1,136) of individuals with osteoarthritis of the hip or knee. Exploratory and confirmatory factor analyses were used to determine the number and content of the dimensions of fear of movement. Factorial invariance was tested across subgroups of gender, race, education, and osteoarthritis severity. Convergent validity with measures of pain, physical functioning, and psychological functioning was examined.

Results—Factor analyses identified a single factor 6-item scale that measures activity avoidance due to pain-related fear of movement (confirmatory factor analysis indices of model fit: RMSEA=.04; SRMR=.01; CFI=.99; TLI=.99). The 6-item scale demonstrated factorial invariance across gender, race, levels of education, and osteoarthritis severity suggesting that this scale performs consistently across diverse groups of individuals with osteoarthritis. Convergent validity with measures of pain (β =.30 to .41), physical functioning (β =.44 to .48), and psychological functioning (β =.36 to .37) was also demonstrated.

Conclusion—The brief fear of movement scale identified in this study provides a promising and valid approach for assessing fear of movement in individuals with osteoarthritis. This brief scale

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Conflicts of Interest:

None

demonstrated several important strengths including a small number of items, sound psychometric properties, and consistent performance across diverse groups of individuals with osteoarthritis.

Fear of movement, or kinesiophobia, is described as a debilitating fear of physical movement and activity that an individual believes will cause pain, injury, or re-injury¹. Fear of movement has been studied in diverse patient populations (e.g., chronic low back pain, chronic fatigue syndrome) and has been associated with increased pain, physical disability, and psychological disability². Recent experimental data suggest that pain-related fear of movement and avoidance can be acquired through associative learning³. In patients with osteoarthritis (OA), maintaining a sufficient level of daily activity is critical to managing pain and disability associated with the disease⁴, but individuals who experience fear of movement may be hesitant to initiate or engage in daily activity.

Fear of movement has important clinical implications for individuals with OA⁵⁻⁹ and is increasingly a target of interventions aimed at reducing OA-related disability^{10,11}. Several studies have demonstrated the negative impact of fear of movement on individuals with OA⁵⁻⁹. In a recent study⁶ in knee OA, fear of movement was significantly associated with greater psychological disability and slower gait speed after accounting for demographic and medical variables. Another study⁷ in OA indicated that fear of movement explained a significant proportion of variance in physical disability after controlling for pain and radiographic findings.

The lack of a validated fear of movement scale for OA, measurement problems, and the length of existing scales limit the widespread assessment of fear of movement in OA. Because the validity of a measure is dependent on the specific population being examined¹², determining the appropriate structure and content of a fear of movement scale for OA is necessary. Findings from other samples of patients with persistent pain may not apply to OA. Beliefs about pain and movement may differ across populations and healthcare providers' recommendations regarding physical activity could vary based on medical diagnosis¹³. Fear of movement scales designed for other populations (e.g., chronic pain, accident-related injury) may not be appropriate for use in OA. Disease-related pain due to OA usually occurs gradually over time, does not necessarily occur in response to a specific event or accident, and may worsen over time due to disease progression.

The present study was conducted to establish a brief fear of movement scale for use in OA. Items from the most widely used measure of fear of movement, the Tampa Scale for Kinesiophobia (TSK)¹⁴, were examined. The measurement properties of the TSK have been evaluated in patients with chronic and acute back pain¹⁵⁻²³, fibromyalgia^{16,17,24}, and musculoskeletal pain^{13,19}. Two relatively small studies have examined the properties of the TSK in OA^{7,25}, but these studies reported conflicting findings. Heuts and colleagues⁷ used confirmatory factor analysis to compare various structures of the TSK in individuals with OA and found a two factor structure. However, several TSK items did not perform well and exhibited low factor loadings. In another OA sample, Mielenz et al.²⁵ found a one factor solution for the TSK. Item response theory analyses showed that one item (item 13) that was retained in the Heuts et al.⁷ study performed poorly and the authors recommended dropping it from the scale. Given conflicting findings across these two studies, the TSK dimensions and items appropriate for use in OA remain unclear.

The present study included a large (N=1,136) community-based sample of African American and White men and women with OA of the hip or knee. This study examined the number and content of the dimensions of the TSK in an OA sample, identified a brief fear of movement scale for use in OA, and tested the convergent validity of the identified fear of movement scale.

Materials and Methods

Participants

This study included participants in the Johnston County Osteoarthritis (JoCo OA) Project, a longitudinal, population-based study of the onset and progression of OA in a semirural North Carolina county. The JoCo OA project is the largest population-based, longitudinal study in the U.S. to monitor the occurrence and natural history of knee OA among African American and white men and women. Details about project methods are provided elsewhere^{26,27}. The original JoCo OA Project cohort (1991–1998) was selected to be representative of the civilian, noninstitutionalized, English-speaking African American and white population aged >45 years who were residents of Johnston County for at least one year. A cohort enrichment occurred between 2003–2004²⁸. The sample for this analysis was derived from individuals from both these recruitments who participated in the second follow-up of the study (conducted 2006–2010). The current sample included 1,136 participants who had radiographic knee or hip OA and completed the TSK.

Measures

OA Grade—Knee radiographs were obtained in standard format with foot map positioning and assessed by a single radiologist (JBR) for Kellgren-Lawrence (K/L) grade using a standard knee atlas²⁹. K/L grades for the tibiofemoral joint were defined as follows: 0=no OA, 1=questionable OA, 2=mild OA, 3=moderate OA, and 4=severe OA²⁹. Participants with films suggesting underlying inflammatory arthropathy were eliminated from this analysis. Knee OA was defined as K/L grade of >2 in at least one knee. Hip OA was derived from anteroposterior pelvis films, also using the K/L scoring system, with OA defined as K/L grade >2 in at least one hip.

Fear of Movement—The TSK¹⁴ was examined to provide a brief fear of movement scale that is valid and reliable in people with OA. The original TSK is a self-report measure assessing the fear of injury/re-injury due to movement. The instrument consists of 17 items scored on a 4-point scale from “strongly agree” to “strongly disagree.”

Pain—Pain was assessed with three measures: a) The short form of the McGill Pain Questionnaire (SF-MPQ)³⁰ contains 11 questions referring to the sensory dimension of pain and four related to the affective dimension. Each descriptor is ranked on a four point scale (0=none to 3=severe). This variable is referred to as Pain Description (Cronbach’s alpha in this sample=.66). b) Pain intensity was measured on an 11-point numeric pain rating scale (0–10), with higher numbers indicating higher pain. The numeric pain rating has been found to be a reliable and valid measure of pain intensity³¹. c) Pain was assessed with the pain subscale of the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)³². The WOMAC is a well-established scale designed to assess pain, stiffness, and function in lower extremity OA. The total range of scores on the pain subscale is 0–20 with higher scores indicating higher pain (Cronbach’s alpha in this sample=.94).

Physical Functioning—Physical function was assessed with two measures. a) The WOMAC physical function scale³² can range from 0–68 with higher scores indicating greater problems with physical functioning (Cronbach’s alpha in this sample=.98). b) The Health Assessment Questionnaire (HAQ)³³ is a measure of disability in arthritis. The HAQ includes 20 activities of daily living questions grouped into eight categories. Level of difficulty over the previous week is recorded (0=no difficulty to 3=unable to do). Cronbach’s alpha was .95 in this sample.

Psychological function—Two measures assessed psychological function. a) The five-item psychological function subscale of the Arthritis Impact Measurement Scales³⁴ measured anxiety and tension (AIMS-anxiety). Cronbach's alpha was .85 in this sample. b) Depressive symptoms were measured with the Center for Epidemiological Studies-Depression scale (CES-D)³⁵. This 20-item scale assesses how often depressive symptoms have occurred in the past week (Cronbach's alpha in this sample=.76).

Statistical Analysis

To examine the TSK factor structure, the sample was randomly divided into two equally sized subsamples. The two subsamples did not differ significantly ($p > .10$) on demographic, medical, or study variables. Exploratory factor analysis (EFA) was conducted in the first subsample. EFA provides more information about item performance than confirmatory factor analysis (CFA) and is preferred when the number of factors is unclear³⁶. Maximum likelihood EFA was conducted with oblique quartimin rotation³⁷ when more than one factor was extracted³⁸. CFA was conducted in the second subsample to examine the fit of the model identified using EFA in the first subsample. EFA and CFA were conducted using Mplus 5.1³⁹. Several indices were used to examine model fit: root mean square error of approximation (RMSEA), the standardized root mean square residual (SRMSR), the comparative fit index (CFI), the Tucker-Lewis Index (TLI), and the Consistent Akaike Information Criterion (CAIC). Factorial invariance across subgroups of gender, race, education, and OA grade was examined in the total sample using the procedures recommended by Dimitrov⁴⁰. Multiple regression analyses were conducted for the full sample to examine convergent validity.

Results

Participants

Participants had a mean age of 71.54 ($SD=9.14$) years and an average education of 13.64 ($SD=4.13$) years. The sample was 68.7% women and 31.3% men. Over half (59.1%) of participants were married. The sample was 71.7% White and 28.3% African American. Forty-five percent of participants had knee OA, 33% had hip OA, and 22% had both hip and knee OA. Participants with knee OA had the following OA grades in the worse severity knee: 1=4.2%, 2=34%, 3=29.2%, and 4=32.7%. Participants with hip OA had the following OA grades: 1=26.5%, 2=66.2%, 3=5.0%, and 4=2.3%.

Item descriptive statistics

Table 1 displays descriptive statistics for the 17 TSK items. Items were approximately normally distributed with the exception of item 6 (skew=1.01). For item 6, 10% ($n=110$) of participants indicated that the item did not apply to them. Among the remaining participants, 44% strongly disagree, 31% disagree, 11% agree, and 4% strongly agree.

Exploratory Factor Analysis (EFA)

EFA was conducted in the first subsample ($N=568$) with all 17 TSK items. While four eigenvalues exceeded the Kaiser-Guttman criteria⁴¹ of 1.0 (5.07, 2.16, 1.34, and 1.23), the scree test⁴² suggested a two-factor solution. We first extracted a two-factor solution as suggested by the scree test. The data were then under and over-factored by extracting one and three-factor solutions. Fit indices for each model are displayed in Table 2. The two-factor solution demonstrated mediocre fit. Examination of factor loadings for the two-factor extraction showed that item 6 failed to load on a single factor (loadings=.33 and .20; communality=.19) and loadings did not improve in the one and three-factor extractions. Consistent with prior TSK studies^{7,16,17,19,25,43} the four reverse scored items (4, 8, 12, and

16) failed to load on a single factor and exhibited low communalities (.01 to .07) in all three factor extractions.

After dropping item 6 and the four reverse scored items, we reran the EFA. For the remaining 12 TSK items, the Kaiser-Guttman criteria⁴¹ and the scree test⁴² suggested a two factor solution. We examined a two-factor solution and then under and over-factored by extracting one and three-factors. Indices of model fit are displayed in Table 2. The two factor solution demonstrated fair fit. The results of the two-factor extraction are displayed in Table 3. Multiple studies conducted in other pain populations^{7,16,17,19,21,43} have found that TSK items comprise an Activity Avoidance factor and a Harm/Somatic Focus factor. Table 3 displays items in this order for ease of comparison with prior studies. Of the Activity Avoidance items, items 13 and 17 had low loadings (.31) and low communalities (.21). The four Harm/Somatic Focus items failed to load on a single factor. Items 3 and 5 loaded on the second factor, while items 7 and 11 loaded more highly on the first factor. When one and three-factors were extracted, factor loadings did not improve. The three-factor solution was clearly over-factored, as only one item (Item 1) loaded on the third factor.

Based on the two-factor solution with 12 items, we dropped the two Activity Avoidance items (13 and 17) that exhibited poor factor loadings and communalities. We also dropped the four Harm/Somatic Focus items (3, 5, 7, and 11) because these items failed to load on the same factor, and two of the items (7 and 11) had fairly low factor loadings and communalities (see Table 3). The six remaining items from the TSK were then examined. For the remaining six items, the Kaiser-Guttman criteria⁴¹ and the scree test⁴² suggested a one-factor solution. The results of the one-factor extraction are displayed in Table 3. All six items exhibited adequate factor loadings and communalities. Fit indices indicated close model fit (see Table 2), with the exception of RMSEA (=13), which was high. Modification indices provided by Mplus 5.1 were examined due to the high RMSEA. Modification indices suggested that the unique variances of similarly worded items 14 and 15 were correlated, which resulted in a high RMSEA value. To further explore the impact of overlapping items 14 and 15 on model fit, we conducted an additional EFA dropping the weaker of the two items (item 14). Indices of model fit were improved (see Table 2) and all five items exhibited adequate factor loadings and communalities. However, the six item scale was retained in all subsequent analyses because both items 14 and 15 had high factor loadings and communalities.

Confirmatory Factor Analysis (CFA)

CFA was conducted in the second subsample (N=568) to examine the single factor structure with six TSK items identified using EFA in the first subsample. Figure 1 displays the factor loadings and unique variances for the CFA. All indices of fit indicated close model fit (CAIC=6541.67; RMSEA=.04; SRMR=.01; CFI=.99; TLI=.99). Based on EFA results, the CFA model allowed the unique variances of items 14 and 15 to correlate.

Factorial Invariance

Factorial invariance was examined across subgroups of gender, race, education, and OA grade in the total sample. The procedure recommended by Dimitrov⁴⁰ uses a multi-stage forward approach for testing factorial invariance across groups based on chi-square difference tests and examination of change in CFI between nested models. Invariance is accepted if the chi-square difference test is not significant ($\alpha=.05$) and the CFI does not decrease by .01⁴⁴. A logical sequence of increasingly restrictive nested models is examined to test measurement and structural invariance. The sequence begins with an unconstrained model (Model 0). Measurement invariance is examined at three levels: metric (Model 1: factor loadings are invariant), scalar (Model 2: item intercepts are invariant), and item

uniqueness (Model 3: item residuals are invariant). Structural invariance (Model 4) tests for invariant factor variances with invariant factor loadings.

For gender, comparison of models showed that factor loadings were invariant across men and women (Model 1 vs. Model 0: $\chi^2=6.77$, $df=6$, $p=.34$; $\Delta CFI<.001$). Results showed scalar invariance for all items but one; item 14 had a slightly higher intercept for men compared to women (1.90 vs. 1.79, respectively). Partial scalar invariance was confirmed after re-running the model with the intercept for item 14 allowed to vary (Model 2 vs. Model 1: $\chi^2=6.94$, $df=4$, $p=.14$; $\Delta CFI=-.001$). Analyses showed invariance of item uniqueness (Model 3 vs. Model 2: $\chi^2=8.19$, $df=6$, $p=.22$; $\Delta CFI<.001$) and structural invariance across men and women (Model 4 vs. Model 2: $\chi^2=1.47$, $df=1$, $p=.23$; $\Delta CFI<.001$).

Analyses for race showed that factor loadings were invariant across African American and White participants (Model 1 vs. Model 0: $\chi^2=3.79$, $df=6$, $p=.71$; $\Delta CFI=.001$). Scalar invariance was demonstrated for all items but one; item 9 had a slightly higher intercept for White participants compared to African American participants (2.16 vs. 1.99, respectively). Partial scalar invariance was confirmed after re-running the model with the intercept for item 9 allowed to vary (Model 2 vs. Model 1: $\chi^2=7.79$, $df=4$, $p=.10$; $\Delta CFI=-.001$). Analyses showed invariance of item uniqueness (Model 3 vs. Model 2: $\chi^2=8.45$, $df=6$, $p=.21$; $\Delta CFI=-.001$) and structural invariance across African American and White participants (Model 4 vs. Model 2: $\chi^2=0.04$, $df=1$, $p=.84$; $\Delta CFI<.001$).

For education (high school education vs. >high school education), comparison of models showed that factor loadings (Model 1 vs. Model 0: $\chi^2=6.21$, $df=6$, $p=.40$; $\Delta CFI=-.001$) and item intercepts (Model 2 vs. Model 1: $\chi^2=9.27$, $df=5$, $p=.10$; $\Delta CFI=-.001$) were invariant across level of education. Invariance of item uniqueness was found for all items but one; item 15 was found to have greater residual variance in those with high school education compared to those with >high school education (.18 vs. .11, respectively). Partial invariance of item uniqueness was confirmed after re-running the model with the residual variance of item 15 allowed to vary (Model 3 vs. Model 2: $\chi^2=6.91$, $df=5$, $p=.23$; $\Delta CFI=-.001$). Comparison of models showed structural invariance across levels of education (Model 4 vs. Model 2: $\chi^2=0.38$, $df=1$, $p=.54$; $\Delta CFI<.001$).

Analyses for OA Grade (2 mild OA vs. 3 moderate to severe OA) showed that factor loadings (Model 1 vs. Model 0: $\chi^2=9.17$, $df=6$, $p=.16$; $\Delta CFI<.001$) and item intercepts (Model 2 vs. Model 1: $\chi^2=6.97$, $df=5$, $p=.22$; $\Delta CFI=-.001$) were invariant across OA grade. Analyses also showed invariance of item uniqueness (Model 3 vs. Model 2: $\chi^2=8.98$, $df=6$, $p=.17$; $\Delta CFI=-.001$) and structural invariance across OA grade (Model 4 vs. Model 2: $\chi^2=0.04$, $df=1$, $p=.84$; $\Delta CFI<.001$).

Convergent Validity

Table 4 displays correlations and 95% confidence intervals for correlations between the 6-item Brief Fear of Movement Scale and participant characteristics. Multiple regression analyses examined convergent validity of the Brief Fear of Movement Scale while controlling for participant characteristics (see Table 5). Moderate positive associations were found between fear of movement and measures of pain and stiffness ($\beta=.30$ to $.41$). The strongest associations were found between higher scores on the Brief Fear of Movement Scale and higher scores on measures of physical functioning ($\beta=.44$ to $.48$). Moderate positive associations were found between fear of movement and measures of psychological function ($\beta=.36$ to $.37$).

Discussion

The present study identified and evaluated a brief fear of movement scale for use in OA. Exploratory and confirmatory factor analyses identified a Brief Fear of Movement Scale for OA that includes six items from the TSK¹⁴ that capture activity avoidance due to pain-related fear of movement. The Brief Fear of Movement Scale performed consistently across diverse groups of individuals as demonstrated by factorial invariance across gender, race, education, and OA grade. The scale also demonstrated relationships with measures of pain, physical functioning, and psychological functioning indicating that this scale has convergent validity. Taken together, these results indicate that the Brief Fear of Movement Scale provides a valid approach for assessing fear of movement in OA.

An important finding from this work is that the Brief Fear of Movement Scale showed invariance across subgroups of gender, race, education level, and OA grade. Results showed that the structure (factor variances and loadings) of the measure was consistent across the subgroups examined. While slight differences in item intercepts and uniqueness were found in several cases, the small number and magnitude of these differences suggested that this measure performs consistently across subgroups⁴⁰. These results indicate that the Brief Fear of Movement Scale developed in this work can be used in diverse groups of individuals with OA.

The Brief Fear of Movement Scale demonstrated convergent validity with measures of pain, physical functioning, and psychological functioning. The strongest relationships were found between fear of movement and measures of physical function. These findings are consistent with prior studies that have demonstrated a negative impact of fear of movement on functioning in individuals with OA⁵⁻⁹. The Brief Fear of Movement Scale shared approximately 25% of its variance with measures of physical functioning. The Brief Fear of Movement Scale exhibited moderate relationships with pain and psychological functioning, which is consistent with past studies in OA^{6,7}. Finally, the Brief Fear of Movement Scale demonstrated weak associations with OA grade, which is consistent with other work suggesting that fear of movement is important to assess in addition to disease severity⁵⁻⁹.

For the Brief Fear of Movement Scale, we dropped the four reverse scored TSK items, item 6, and items 13 and 17 from the Activity Avoidance factor. This study and numerous studies of the TSK^{7,16,17,19,25,43} have found that the four reverse scored items fail to correlate with other TSK items. Item 6 was dropped because our data suggested that this item might be inappropriate for use in individuals with OA and it failed to correlate with other TSK items. Items 13 and 17 did not load with other TSK items and performed poorly in the analyses. Mielenz et al.²⁵ also reported problems with item 13 in a study of OA and concluded that item 13 had little in common with other TSK items. Item 17 has exhibited low factor loadings in prior studies^{21,24,45-47}, and was among the more poorly performing items in analysis conducted by Mielenz et al.²⁵

We chose to drop the four harm/somatic focus TSK items from the Brief Fear of Movement Scale because these items did not load on a single factor and exhibited fairly low loadings. If future measures include these items, users should be made aware that these four items may not form a single factor. In this study, two items (3 and 5) focused on the seriousness of pain loaded together on a factor, but the two remaining items showed higher loadings on the activity avoidance factor. Additional studies are needed to determine whether these four items capture information that is indicative of fear of movement in individuals with OA. It is possible that the content of these items may be more suggestive of a tendency to catastrophize about pain²⁴, rather than fear of movement.

While this study included a large community based sample of individuals with OA, findings need to be viewed within the particular circumstances of this study. First, this study included a single assessment, which prohibits testing reliability of the scale over time or sensitivity to changes in disease or function over time. Second, all of the variables examined for convergent validity were assessed using self-report measures, which raises possible concerns over common method bias in the estimation of these relationships. Third, these data were collected as part of a population-based study of the onset and progression of OA. Hypotheses and analyses examining the psychometric properties and convergent validity of the Brief Fear of Movement Scale were conducted post hoc. Finally, the study sample included individuals with OA who were living in North Carolina. Additional studies are needed to determine whether these results generalize to individuals living in other geographic regions and to populations with other types of disease related pain.

Fear of movement is an important target for reducing disability in individuals with OA⁵⁻¹⁰. Having a valid measure for assessing fear of movement in OA has important clinical implications. Once identified, pain-related fear of movement could be treated using in vivo exposure techniques. Vlaeyen et al.⁴⁸⁻⁵⁰ have developed in vivo exposure techniques that enable patients with pain to learn that they can successfully experience and habituate to movements or activities that they might normally avoid. These techniques have been found to be effective in decreasing pain and disability in patients with other persistent pain conditions and could be adapted for use in individuals with OA.

The Brief Fear of Movement Scale identified in this study provides a promising and valid approach for assessing fear of movement in OA. This brief scale demonstrated several important strengths including a small number of items, sound psychometric properties, and consistent performance across diverse groups. Future longitudinal and experimental studies are needed to further examine the scale's stability over time and its sensitivity to change.

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Significance and Innovation

- Fear of movement has important clinical implications for individuals with osteoarthritis including increased pain, physical disability, and psychological disability. It is increasingly a target of interventions aimed at reducing osteoarthritis-related disability.
- The lack of a validated fear of movement scale for osteoarthritis, measurement problems, and the length of existing scales limit the widespread assessment of fear of movement in osteoarthritis clinical and research settings.
- The present study identified and evaluated a Brief Fear of Movement Scale for use in osteoarthritis based on the most widely used fear of movement scale, the Tampa Scale for Kinesiophobia (TSK).
- The Brief Fear of Movement Scale identified in this study demonstrated several important strengths including a small number of items (i.e. six items), sound psychometric properties, and consistent performance across diverse groups of individuals with osteoarthritis.

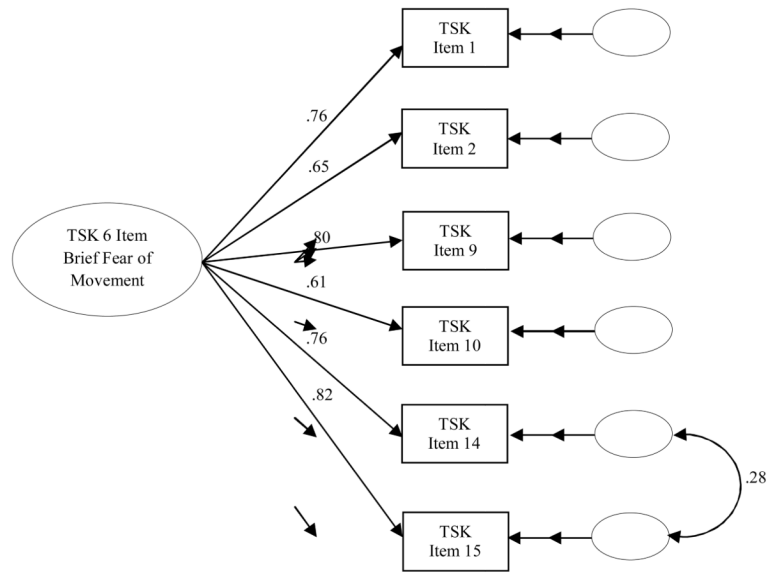


Figure 1. Confirmatory factor analysis for TSK 6 Item in the second subsample (N=568)

Table 1

TSK item descriptive Statistics (N=1,136)

# ^a	Item	Mean (SD)	Median	Range
1	I am afraid that I may injure myself if I exercise	1.91 (.78)	2.00	1 – 4
2	If I were to try to overcome it, my pain would increase	2.05(.74)	2.00	1 – 4
3	My body is telling me that I have something dangerously wrong	2.21(.91)	2.00	1 – 4
4	My pain would probably be relieved if I were to exercise ^b	2.37(.81)	2.00	1 – 4
5	People are taking my medical condition seriously enough	2.73(.89)	3.00	1 – 4
6	My accident has put my body at risk for the rest of my life ^c	1.72(.84)	2.00	1 – 4
7	Pain always means I have injured my body	1.92(.64)	2.00	1 – 4
8	Just because something aggravated my pain does not mean it's dangerous ^b	2.75(.65)	3.00	1 – 4
9	I am afraid that I might injure myself accidentally	2.12(.80)	2.00	1 – 4
10	Simply being careful that I do not make unnecessary movements is the safest thing I can do to prevent pain from worsening	2.53 (.88)	3.00	1 – 4
11	I wouldn't have this much pain if there wasn't something potentially dangerous going on in my body	1.93(.69)	2.00	1 – 4
12	Although my condition is painful, I would be better off if I were physically active ^b	2.59(.91)	3.00	1 – 4
13	Pain lets me know when to stop exercising so that I don't injure myself	2.83(.68)	3.00	1 – 4
14	It's really not safe for a person with a condition like mine to be physically active	1.91(.73)	3.00	1 – 4
15	I can't do all the things normal people do because it's too easy to get injured	2.03(.79)	2.00	1 – 4
16	Even though something is causing a lot of pain, I don't think it's actually dangerous ^b	2.64(.69)	3.00	1 – 4
17	No one should have to exercise when he/she is in pain	2.42(.69)	2.00	1 – 4

^aThe original TSK item numbers are retained for consistency and to allow for ease of comparison with other studies.

^bItems 4,8,12, and 16 are reversed scored.

^cFor item 6, n=110 participants did not answer the item and indicated that the question did not apply to them.

Table 2

Indices of fit for exploratory factor analysis (EFA) in the first subsample of participants (N=568)

Model	Consistent Akaike Information Criterion (CAIC)	Root Mean Square Error of Approximation (RMSEA)	Standardized Root Mean Square Residual (SRMSR)	Comparative Fit Index (CFI)	Tucker-Lewis Index (TLI)
17 Items					
One factor	18354.21	.12	.10	.70	.66
Two factors	17889.52	.08	.05	.87	.83
Three factors	17803.22	.07	.04	.91	.87
12 Items					
One factor	13672.22	.11	.07	.84	.81
Two factors	13456.81	.08	.04	.93	.90
Three factors	13401.01	.07	.03	.96	.93
6 Items					
One factor	6358.36	.13	.03	.95	.92
5 Items					
One factor	5612.32	.09	.02	.98	.96

Table 3
Exploratory factor analysis (EFA) in the first subsample of participants (N=568)

Item #		TSK 12 Items			TSK 6 Items		
		Factor 1 loading	Factor 2 loading	Communality	Factor Loading	Communality	Communality
<i>Activity Avoidance Items</i>							
1	I am afraid that I may injure myself if I exercise	.73	.01	.54	.75	.56	
2	If I were to try to overcome it, my pain would increase	.67	.04	.47	.68	.46	
9	I am afraid that I might injure myself accidentally	.72	-.04	.49	.70	.49	
10	Simply being careful that I do not make unnecessary movements is the safest thing I can do to prevent pain from worsening	.51	.23	.41	.59	.35	
13	Pain lets me know when to stop exercising so that I don't injure myself	.24	.30	.21			
14	It's really not safe for a person with a condition like mine to be physically active	.82	-.02	.66	.82	.67	
15	I can't do all the things normal people do because it's too easy to get injured	.89	-.03	.76	.87	.75	
17	No one should have to exercise when he/she is in pain	.31	-.04	.09			
<i>Harm/Somatic Focus Items</i>							
3.	My body is telling me that I have something dangerously wrong	.06	.79	.67			
5	People are taking my medical condition seriously enough	-.08	.68	.42			
7	Pain always means I have injured my body	.39	-.20	.13			
11	I wouldn't have this much pain if there wasn't something potentially dangerous going on in my body	.54	.14	.37			
	Variance accounted for by factor	39.6%	12.2%		62.1%		
	Cronbach's alpha for factor items	.85	.54		.87		
Descriptive Statistics:							
	Mean					12.68	
	Standard Deviation					3.72	
	Median					13.00	
	Range					6-24	

Table 4

Correlations examining relationships between participant characteristics and the TSK 6-item Brief Fear of Movement Scale (N=1,136)

	TSK 6 Item Brief Fear of Movement Scale	
	Pearson's and point-biserial correlations	95% CI for correlation
Age (in years)	.21	.15 to .27
Education (in years)	-.29	-.34 to -.23
Gender (0=Male, 1=Female)	.08	.02 to .14
Race (0=White, 1=African American)	.09	.03 to .15
Marital status (0=Not married, 1=Married)	-.14	-.20 to -.09
Worse knee OA grade	.20	.14 to .25
Worse hip OA grade	.17	.12 to .23

Note: All correlations significant at $p < .05$.

Table 5

Multiple regression analysis examining convergent validity of the TSK 6-item Brief Fear of Movement Scale (N=1,136)

	Final standardized β	p	Squared semi-partial r
Dependent Variable: McGill Pain Description			
Age (years)	-.06	.05	.003
Education (years)	-.04	.18	.002
Gender ^a	.06	.05	.003
Race ^b	-.01	.75	.0001
OA grade ^c	.06	.06	.003
TSK 6-item Brief Fear of Movement Scale	.30	<.001	.08
Dependent Variable: McGill Pain Intensity			
Age (years)	-.07	.007	.006
Education (years)	-.04	.21	.001
Gender	.10	<.001	.01
Race	-.02	.42	.0001
OA grade	.16	<.001	.03
TSK 6-item Brief Fear of Movement Scale	.41	<.001	.16
Dependent Variable: WOMAC Pain			
Age (years)	-.15	<.001	.03
Education (years)	-.07	.01	.006
Gender	.08	.002	.009
Race	-.03	.27	.001
OA grade	.23	<.001	.07
TSK 6-item Brief Fear of Movement Scale	.40	<.001	.16
Dependent Variable: WOMAC Stiffness			
Age (years)	-.10	.001	.01
Education (years)	-.08	.01	.006
Gender	.08	.004	.008
Race	-.005	.87	<.0001
OA grade	.22	<.001	.06
TSK 6-item Brief Fear of Movement Scale	.34	<.001	.11
Dependent Variable: WOMAC Function			
Age (years)	-.08	.006	.008
Education (years)	-.08	.006	.008
Gender	.10	<.001	.01
Race	-.001	.96	<.0001
OA grade	.21	<.001	.06
TSK 6-item Brief Fear of Movement Scale	.44	<.001	.20
Dependent Variable: Health Assessment Questionnaire (HAQ)			
Age (years)	.09	.001	.01
Education (years)	-.06	.03	.005

	Final standardized β	p	Squared semi-partial r
Gender	.18	<.001	.05
Race	-.02	.48	.0005
OA grade	.14	<.001	.03
TSK 6-item Brief Fear of Movement Scale	.48	<.001	.25
Dependent Variable: Center for Epidemiologic Studies Depression Scale (CES-D)			
Age (years)	-.10	.001	.01
Education (years)	-.09	.003	.008
Gender	.09	.001	.009
Race	.03	.26	.001
OA grade	-.02	.48	.0004
TSK 6-item Brief Fear of Movement Scale	.37	<.001	.12
Dependent Variable: Arthritis Impact Measurement Scale (AIMS) Anxiety/Tension			
Age (years)	-.16	<.001	.03
Education (years)	.03	.28	.001
Gender	.17	<.001	.03
Race	-.02	.51	.0004
OA grade	-.06	.06	.004
TSK 6-item Brief Fear of Movement Scale	.36	<.001	.12

^aGender coded as 0=men, 1=women

^bRace coded as 0=White, 1=African American

^cOA grade coded as 0=worse hip or knee OA grade mild (i.e., 2), 1=worse hip or knee OA grade moderate to severe (i.e., 3)